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Anatomical Evolution of Pulmonary Tuberculosis.—Instances of infraclavicular and mid-lung localizations of pulmonary tuberculosis are reviewed in 31 roentgenographs from 15 cases. They are of tremendous significance in the development of pulmonary tuberculosis in the adult. The spread of tuberculosis takes place either as perifocal inflammations, as mid-field infiltrations, early and late infiltrations, or as tuberculous peribronchitis. The two basically different forms have, as their foundation, a different allergic condition. Those forms that proceed as outspoken perifocal inflammations are secondarily allergic, while a tuberculosis peribronchitis, emanating from the hilum and united with it by string-like bands, has not appreciably broken down the immunity of the tertiary stage. Apparently isolated apical tuberculosis can be regarded as the end-stages of an ascending spread along the bronchi. Apical foci are not the beginning but rather the conclusion of an extending process.—*Die Formen der infraclaviculären und Mittelfeldprozesse; ihre Bedeutung für Entwicklung und Verlauf der Lungentuberkulose des Erwachsenen, H. Alexander, Zeitschr. f. Tuberk., 1928, l, 3.*—(*H. J. C.*)

Development of Pulmonary Tuberculosis.—Every new phthisical focus begins with an exudative phase. It may then be resorbed, it may become fibrosed, or it may caseate and liquefy. Every local progression with beginning or increasing destruction occurs with an exudative exacerbation; this is true, too, for productive foci. From a clinical standpoint tuberculosis can be classified and usually diagnosed according to the three developmental stages of the disease, that is, the period of primary infection, the period of endogenous, lympho-haematogenous propagation, and the period of aerogenous-bronchogenic superinfection. Within the manifestations of each period, the development of foci of the exudative-resorptive, exudative-productive or exudative-caseous type is possible and clinically necessary. In each of the three periods, the production of a true phthisis, that is, bronchogenic, destructive, and progressive lesions is possible. During the primary period the progression occurs in exudative-caseous lesions by direct continuity, in the secondary period it occurs by the bronchogenic spread from a haematogenous focus which ruptured into the bronchial tree. In the third period the first focus is produced by an aerogenous

superinfection. The phthisis of the secondary stage is the same as that described by some authors as phthisis of old age, or the fibrotic-ulcerative phthisis of the French school, or the type of pulmonary tuberculosis which, according to Loeschcke, originates from so called apical tuberculosis. The tertiary form is the same as Aschoff's phthisis of reinfection, the isolated phthisis of Ranke, the fibrotic-caseous phthisis of Neumann, and the phthisis which has recently been described as originating from so called early infiltrations. The tertiary phthisis begins always with large infiltrations. They are independent of coexisting apical scars. But not every early infiltration is the inception of progressive phthisis, since many of them are resorbed or fibrosed without destruction. If they undergo fibrosis, their final development leads to the formation of the so called Aschoff-Puhl focus. Whether early infiltrations may be produced by a hematogenous propagation is still uncertain.—*Über Entstehung und Verlauf der phthisischen Reinfektsperiode, W. Starlinger, Klin. Wchnschr., February 26, 1929, ix, 410.—(M. P.)*

Evolution, Activity and Regression in Tuberculosis.—The roentgenographic studies of Jacquerod, Giraud and Piguet, Burnand, Turban and Staub, Sergent, Jacob, and others are cited, and a new series shown. The importance of serial roentgenographs in studying these phases is emphasized. There are 6 brief cases reports, with illustrations. No special therapeusis had been applied except pneumothorax, in addition to simple hygienic-dietetic treatment. Roentgenographic observations permit one to determine and distinguish suppurative or potentially suppurative pulmonary foci from adjacent zones of regressive evolution up to the point of complete "drying up." On the other hand, one may often observe, instead, extension of destruction, or progressive evolution, sometimes not revealed by any of the recognized physical signs. In between these different phases are cases in which repeated roentgenographs are almost identical, usually said to be of "torpid evolution." Actually, it is a mistake to speak of evolution at all in such cases. Here, notions of activity may conflict with those of evolution. Rist holds that, with few exceptions, all open tuberculosis is active. Sergent, distinguishing between *active* and *evolutive* tuberculosis, added in 1918 that the first is a tuberculosis persistently bacilliferous but often limited and not encroaching on new territory; the second is not only active but progressive. It seems that serial roentgenography should be supplemented by careful bacilloscopy at regular intervals. Cases showing repeatedly identical pictures often represent the favorable termination or inactive stabilization of a process. When, however, the tubercle bacillus persists, there is great liability to renewal and exacerbations of evolution, with thermic episodes, and such cases cannot be considered stable. Particularly interesting are intermittently bacillary cases. In all these serial roentgenographs are most valuable, often revealing significant though minimal changes. Roentgenographic observations are still needed to establish these points: *1:* That in the adult a constantly bacilliferous tuberculosis may persist without demonstrable roentgenographic changes over weeks or months. *2:* That parenchymal lesions (other than generalized miliary or massive pneumonic tuberculosis) may occur and progress without the determination of tubercle bacilli on careful and repeated search. No case of this kind has been seen among over 1600 films collected at Bligny since 1923. *Provisional Conclusions: 1:* Regressive evolution may occur with or without activity and is most surely demonstrated by serial roentgenography. *2:* Progressive evolution is always accompanied by activity, as indicated by positive bacilloscopy, apart from certain massive pneumonic and generalized miliary lesions. *3:* So called "torpid activity" is a misnomer. *4:* The notion of activity, properly called, supplements that of evolution. It may be accidental, transitory or discontinuous, with alternating tranquil phases showing for a long time stabilized serial pictures. Sustained activity always implies evolution, variable in degree and consequences, with definite if slight roentgenographic changes. *5:* Instantaneous teleoroentgenographs, taken under identical conditions, are required to show these changes. Fourteen excellent full-page reproductions of films accompany the paper.—*Contribution à l'étude de la notion d'évolution et de la notion d'activité: Évolution régressive avec ou sans activité apparente, U. Guinard, Section d'études scientifiques de l'Oeuvre de la Tuberculose, January 14, 1928, reported in Rev. d. l. Tuberc., April, 1928, ix, 222.—(A. P.)*

Early Infiltration in Pulmonary Tuberculosis.—Twenty cases of pulmonary tuberculosis are reported which were characterized by a short history of indefinite ill health, very slight and variable physical signs, and X-ray studies of the chest which revealed an early infraclavicular lesion. The early infiltration may be a transient condition, healing to leave only a scar, which may later be discovered and considered to be the

early manifestation of the disease, but which in fact is the end-result of an attack of pulmonary tuberculosis.—*The Early Infiltration and its Relation to the Development of Phthisis, H. V. Morlock, Tubercle, March, 1929, x, 267.*—(*W. I. W.*)

Infraclavicular Infiltrations of Lungs.—During recent years special attention has been given to the precise form of pathological development of the tuberculous process in the lungs. For a long time we believed in a slow and undermining involvement of the apices. We localized the initial process at the top of the lungs, and considered that the most important point in early diagnosis was the detection of this apical lesion as early as possible. Nowadays, as the result of new investigations, the apices are beginning to lose somewhat their unique and predominant importance, and much more interest is being aroused in the evidences of so called infraclavicular early infiltration. It is now generally conceded by clinicians that pulmonary tuberculosis very frequently starts lower down in the lungs than the apices, and requires special methods of examination for arriving at an accurate diagnosis and also special treatment. The acute character of the early infraclavicular infiltration is generally admitted. The pathologists, however, keep up the idea of a primary apical focus. Many clinicians still believe that the early infraclavicular infiltration is really a spread from old primary foci in the apices. After a study of papers, reports and discussions and taking into account his own large experience, the author concludes as follows: *1:* Many cases of so called chronic pulmonnary tuberculosis do not develop from lesions in the apices, but originate as a diffuse or disseminated early tuberculous infiltration lower down in the lung. *2:* Against our up-to-date belief in a slow and undermining development extending from the top of the lungs, this early onset starts as an acute process, and sometimes is manifested clinically as a febrile affection like acute influenza. *3:* In all cases of suspected pulmonary tuberculosis we must examine carefully not only the apices, but especially the infraclavicular region and also the axilla, by means of percussion and auscultation, and careful and repeated roentgen-ray investigations. These are absolutely essential and also frequent sputum examinations should be made. *4:* Often the formation of an early cavity can be seen by means of roentgen-ray examinations. Such cavities should not be treated conservatively but by the production as soon as possible of an artificial pneumothorax. This should be carried out before adhesions form and before a further spread of the tuberculous process takes place. *5:* Careful watching is necessary also in cases without destructive processes. These patients must be treated by absolute rest at the beginning, best maintained by retaining the patients in bed, and no irritating or stimulating therapeutics are to be allowed. *6:* The author's personal opinion is that this so called early infraclavicular infiltration is a special form of the development of pulmonary tuberculosis, occurring, perhaps, in relation to previous influenzal infection, and varying in different individuals according to immunization and biological resisting powers. *7:* Whether pulmonary tuberculosis develops after a primary lesion at the very top of the lung, or as a primary lesion in this situation, or independently, is not yet clear. We have, however, to deal with this class of case, and must look out for these special examples carefully, and study them more in detail. *8:* In any case the careful examination of the apices themselves is not to be neglected. Even if it is shown that affection of the extreme apex is comparatively "harmless," each case must be watched, for some spreading of the tuberculous process to other parts is undoubtedly always possible.—*The Diagnosis and Treatment of "Infraclavicular Early Tuberculous Infiltration" of the Lungs, O. Amrein, Brit. J. Tuberc., October, 1928, xxii, 170.*—(*J. S. W.*)

Infraclavicular Foci.—Infraclavicular infiltrations represent scattered foci that may have come from an apical focus. That progressive pulmonary tuberculosis does not have to begin at the apex is proved by the presence of a primary focus in other areas than the apex, especially in children.—*Zum pathologischen Anatomie des infraklavikuloren Infiltrates, Pagel, Deutsche med. Wchnschr., March 8, 1929, lv, 394.*—(*H. S. W.*)

Apical and Infraclavicular Infiltrations.—The authors review an X-ray material, covering 2,900 cases, for the presence of apical and infraclavicular infiltrations. On account of the long interval existing between the origin of the infiltrations and admission to the sanatorium, no "fresh" infiltrations were found. The majority of the cases were in the stage of small flocculent aspiration foci or of beginning disintegration. In the 2,900 roentgen films there were 55 with apical shadows and 45 with infraclavicular infiltration, 6 of the latter showing healing. The distribution of men and women with both forms of tuberculosis was about the same. Of the 55 with

apical disease there were 9 open cases, 28 with clinical symptoms definite, 10 questionable, and 17 with clinical symptoms absent. Of the 45 with infraclavicular infiltration there were 19 open cases, 30 with definite clinical symptoms, 4 questionable, and 11 with no symptoms. An absolute restriction of infraclavicular infiltrations to ages under 30 years could not be determined from this study.—*Das Verhältnis der Spitzenerkrankungen und der infraclaviculären Infiltrate in der Heilstätte, W. Münchbach, and K. Riemer, Beitr. z. Klin. d. Tuberk., 1928, lxviii, 98.*—(*H. J. C.*)

Roentgenography of Nodular Sclerosis of Lungs.—The roentgenographic appearance in this condition suggests miliary tuberculosis, and even the macroscopic appearance of the lung is that of a generalized fibrous miliary tuberculosis; with all this, there is entire absence of specific tuberculous lesions. *Case Report:* A man, 53 years of age, had a long history of cough, and was easily dyspnoeic. On auscultation there were disseminated squeaks and pleural friction sounds at the right base. There was slight mucopurulent expectoration, which never showed tubercle bacilli, even after incubation and homogenization. Among the functional symptoms were dyspeptic troubles, which five months later were sufficiently aggravated to necessitate gastroenterostomy; extensive pyloric induration was found, with adjacent peritoneal reaction and adhesions, but no ulceration. Roentgenographs showed diminished transparence of the pulmonary fields, with a granite-like stippling suggestive of miliary tuberculosis. Some of these formed corymb-like masses. Bezançon, Braun and Duhamel have attributed these to a subacute fibrous form of tuberculosis, but pathological studies cast some doubt on this. *Pathological Morphology:* The lungs are small and contracted, blackish and rubbery, their cut-surface showing islands of sclerosis, as blackish granulations on a spongy base. There is bronchial dilatation and peribronchial sclerosis. The initial stage in the formation of the granulations is a subacute alveolitis, tending toward fibrous obliteration. The connective-tissue network proliferates, compressing the air-cells within. Later, nodules become evident and finally fibrous blocs with intercrossing bands. There are no zones of caseation, no giant cells, and no typical follicular lesions of tuberculosis, No tubercle bacilli can be found, but there is a microbic flora rich in gram-staining rods. The aetiology remains undetermined and the difficulty of interpretation of roentgenographic pictures of this sort is thus increased.—*Sclérose nodulaire du poumon à images radiographiques granitées, Macaigne and Nicaud, Section d'études scientifiques de l'Oeuvre de la Tuberculose, March 10, 1928, reported in Rev. d. l. Tuberc., June, 1928, ix, 411.*—(*A. P.*)

Disseminated Calcific Pulmonary Tuberculosis with Longstanding Fever.—Numerous attempts at classifying the clinical forms of tuberculosis have been proposed. None has been entirely satisfactory, manifesting the difficulty in putting in order the great quantity of facts accumulated in the past twenty years. Probably we shall end with a simpler conception of the different aspects assumed by human tuberculous infection. The present report deals with a particular morbid entity mentioned by several authors, notably Burnand. *Case Report:* A chambermaid, aged 32, with father and mother and 5 brothers and sisters living, and no known tuberculous antecedents, suffered at the age of 21 for about six months a severe attack of furunculosis, causing weakness and attacks of slight fever, but no wasting, cough or expectoration. A little later she noticed slight oedema of the feet. She came to Leysin in 1915, not as a patient, but to work, feeling, however, slightly asthenic, and consulted a physician. Physical and fluoroscopic examinations were negative, and there was no cough or sputum; still the slight febrile state persisted, with evening elevations of 37.8° to 38.4°C. Rest in bed failed to influence this, and the general condition was good. There was slight persistent malleolar oedema. In July, 1917, there was slightly rude respiration on the right and a slight systolic murmur over the mitral area of the heart. No other signs indicative of infectious endocarditis were present and three blood cultures were negative. A blood Wassermann was found positive and novarsenobenzol treatment appeared to favorably affect the oedema but not the fever. She was then lost sight of until the spring of 1920, when her condition appeared practically the same, and except for short periods the slight fever had persisted. On this occasion, for the first time, she showed an area of fine râles in the left spinous fossa. These, however, disappeared after a few months. Fluoroscopy showed a slight haziness in this area. In September, 1923, for the first time, following a febrile attack, she had a slight haemoptysis, followed by sputum containing a few tubercle bacilli on two occasions. A roentgenographic film showed in the upper half of the pulmonary fields, most marked on the left, numerous small clearly defined and rounded densities, with a slight cloudy mottling.

Another film in April, 1927, was almost identical. In July, 1927, there was again a small quantity of bacillary sputum. *Discussion of Important Features: 1: Calcific Pulmonary Lesions:* The films show a very characteristic picture, the interpretation of which is obvious and beyond doubt. There are numerous clear-cut shadows representing calcified tuberculous lesions in the upper half of the pulmonary fields, especially marked on the left. Some such shadows are ordinarily present near the hilum and then considered as very old original lesions, but such are rarely numerous. These lesions, on the other hand, are (1) extensively disseminated through the pulmonary fields; (2) very numerous; and (3) of rapid development. A review of the case, with the X-ray films, shows that they must have developed between March and September, 1923, as on the former and prior occasions nothing abnormal was noted except a slight apical veil. The fact of a positive Wassermann is of some interest. *2: Prolonged Febrile State without Apparent Evolution of Lesions:* As tubercle bacilli and the above lesions were demonstrable, it seems logical to connect the two. Disconcerting features are: *1:* The disproportion between the febrile changes and the lesions which until quite late remained insignificant. May there not have been tuberculous lesions elsewhere? Possibly, but the symptoms did not point to any, nor did careful repeated examinations. *2:* Although numerous authors, including Burnand, have described long-standing bacillary states without apparent lesions, none has furnished absolute bacteriological proof of their nature. In this case, although we have bacteriological proof, it is essential to eliminate other possible causes, such as Rist has referred to,—for instance, sinuses, pelvic organs, thyroid, etc. Chronic infectious endocarditis can be eliminated by the absence of characteristic signs and the long duration (ten years). The type of fever is not that of malaria and the patient has never left Switzerland. Dysentery and Malta fever are likewise ruled out. *Conclusions:* It seems clearly established that a tuberculous infection, apparently insignificant and nonprogressive, may provoke a prolonged febrile elevation. One is inclined to agree with Bezançon, contrary to Burnand's notions, that the latter's so called "chronic bacillary states" are really due to discrete lesions somewhere. Suppose, in the case reported, they had been intestinal instead of pulmonary, who could have discovered them? *3:* In the presence of cryptogenic fevers tuberculosis is always to be kept in mind, as of all chronic diseases it is most common. Fever of so called endocrine or sympathetic origin must be carefully investigated and one should not speak of "chronic bacillary states" but rather search for localized lesions.—*Tuberculose pulmonaire calcifiante à foyers disséminés avec état febriles durant depuis douze ans, A. Giraud and C. A. Piguet, Section d'études scientifiques de l'Oeuvre de la Tuberculose, November 12, 1927, reported in Rev. d. l. Tuberc., February, 1928, ix, 87.*—(*A. P.*)

Hilum Tuberculosis in Old Man.—The case reported was that of a man of 59 with diabetes mellitus of two years' and tuberculosis of six months' duration. Necropsy findings showed bilateral acinonodose phthisis spreading from the hilum, with early cavity-formation, the apices being clear. There was also a miliary dissemination and a pneumococcus lobar pneumonia of the left lung, cirrhosis of the liver and arteriosclerosis. The man was a native of New England and had been a steamboat engineer for forty years. There was no known exposure to tuberculosis. The chest signs consisted principally of medium and fine râles, axillary and subscapular on the right. Roentgenographs showed extensive consolidation of the lower two-thirds of the right upper lobe and about the left hilum, where two clear areas suggested cavitation. The sputum contained many tubercle bacilli, the urine 6 per cent sugar and the blood sugar was 200 mgm. per 100 cc. Death occurred a few days after transfer to a sanatorium. Microscopic examination of the lungs showed tuberculous bronchopneumonia, miliary tubercles, and croupous pneumonia. Both pneumococci and tubercle bacilli were demonstable by special stains. *Summary:* The notion of older observers that pulmonary phthisis of the adult invariably begins at the apex is obsolete. In a high percentage, including especially the more serious cases, the disease begins in the subclavicular or perihilar region, whence it spreads. Likewise, the conception of endogenous reinfection residual from infancy being the important factor is disputed and exogenous reinfection of the lungs in adults is now regarded as more common.—*Hilum Tuberculosis in an Old Man, B. M. Fried, New England J. M., January 31, 1929, cc. 233.*—(*A. P.*)

Cavities in Pulmonary Tuberculosis.—Roentgenological and pathological studies reveal three main types of pulmonary cavities: *1:* Small, multiple cavities in a densely infiltrated parenchyma. These cavities are often described as "moth-eaten areas;" they represent a defenseless condition. *2:* Sharply defined, almost completely

round or slightly oval cavities, either with heavy perifocal infiltration or with thin, clearly defined borders. The "round cavity" shows incipient defense against an acute lesion. *3:* Irregularly shaped cavities with dense walls, often of grotesque shape with marked irregularities in the walls. This fibrotic cavity is a manifestation of chronicity, slow progression or standstill. In considering cavities from this point of view, the imminent danger of bronchogenic spread must not be lost sight of.—*The Cavity in Pulmonary Tuberculosis, M. Pinner, Am. J. Roentgenol. & Rad. Thera., December, 1928, xx, 518.*—(*W. I. W.*)

Healing of Pulmonary Tuberculosis during Athletic Training.—This is a detailed case report of a girl, 18 years old, examined routinely during training for championship swimming for two years. Her mother had recently died of open pulmonary tuberculosis in the home. The general condition of the patient was excellent and she had no complaints whatever, and did not recall the slighest illness since childhood. Physical and roentgenological examinations revealed fairly extensive, fibrosed lesions in both infraclavicular fields; they had the characteristic appearance of what is called, according to Redeker, "induration fields." The blood picture showed a marked shifting to the left; otherwise all clinical and laboratory examinations were negative. This case is of interest because it shows that acute infiltrative lesions may develop and fibrose even under excessive physical strain, without producing any symptoms.—*Lungentuberkulose und sportliches Training, Nervegno, Klin. Wchnschr., March 26, 1929, viii, 602.*—(*M. P.*)

Formation of Bone in Experimental Tuberculosis.—A number of guinea pigs was infected with tissues from lesions of lupus planus. These animals developed very slowly progressive lesions, which consisted of typical tubercles with very little or no caseation. In the lungs the same type of tubercles was found and interstitial pneumonic foci with the production of much fibrosis, and hypertrophy of the epithelium in the bronchioli, which yielded pictures similar to adenomata. Within the connective tissue, islets of bone tissue were formed with a typical osteoid stage before the development of true bone. The extent of the bone-formation was quite considerable in some of the animals, and was associated with the appearance of typical bone-marrow.—*Über die Entwicklung von Knochengewebe in der Lunge der mit Tuberkulose infizierten Meerschweinchen, S. S. Wail, Centrbl. f. allg. Path. u path. Anat., December 10, 1928, xliv, 101.*—(*M. P.*)

Thrombosis of Pulmonary Arteries.—A single white woman, aged 38, had marked shortness of breath, with cyanosis on slight exertion, gradually becoming worse over a period of months. Physical examination and laboratory and X-ray studies failed to reveal the cause of these symptoms, which were tentatively diagnosed by two observers as due to neurocirculatory asthenia. The blood-pressure was 92/68. The pulse-range was 100 to 110, and respirations 20 to 30. There was no elevation of temperature. An electrocardiograph showed a right ventricular preponderance, with inverted T wave in both the second and third leads. Symptoms became progressively worse, and death occurred nine days after admission to the Peter Bent Brigham Hospital. Autopsy disclosed extensive thrombosis of the smaller branches of the pulmonary arteries with resulting infarctions and injury to lung tissue. From gross and histological study it appeared that the oldest as well as the most recent lesions were to be found in the minute arteries, and that the thrombosis traveled by centripetal propagation, with organization and canalization. The acute lesion, consisting in swelling and cellular infiltration of the vessel wall, presumably represented an early if not the initial damage. The infiltrating cells for the greater part were mononuclears (macrophages), which raised the possibility of an infectious agent as a causative factor. One hypothesis is that the lungs in this case may have been the seat of an extensive interstitial pneumonitis. This is suggested by the generalized fibrosis and many tubercle-like lesions adjacent to the bronchi, blood-vessels and connective-tissue structures of the lung, all regions of lymphatic channels. The closest analogous vascular pathological changes are to be found in the disease known as *thromboangitis obliterans.* In the cases cited from the literature the outstanding symptoms were usually cardiac, but in this case the heart-muscle had not given way to a great extent. The lesions in the blood-vessels in this case are certainly different from ordinary arteriosclerosis, as well as from lesions due to syphilis, and also from the cases of thrombosis of the pulmonary arteries that have been reported.—*A Case of Extensive Bilateral Progressive Thrombosis of the Smaller Branches of the Pulmonary Arteries, C. Frothingham, Am. J. Path., January, 1929, v, 11.*—(*E. H. K.*)

Pleural Path of Tuberculous Infection of Lung Apex.—That adult pulmonary

tuberculosis is often a reactivation of childhood infection is generally accepted, but the cause of such reactivation is disputed. Certain general causes are mentioned, affecting the whole body, but these have no bearing on the habitual localization of the process in the upper parts of the lung and pleura. Aerial reinfection is not now regarded as a satisfactory explanation. About twenty years ago the lymphatic pathways between the neck and pulmonic apex were much discussed, and considerable experimental work of injection of these channels was done by Most and Beitzke, particularly in the cadavers of newborn children, and later in a few tuberculous adults, but no direct connections between the neck and thoracic cavity were found. The theory of apical predisposition based on feeble respiration of the upper parts of the lung has been advanced but never proved; opposed to it is the uniform dissemination of the lesions of pneumonokoniosis. *Exposure of the Apex and Pleural Dome to Adjacent Lesions:* There is no place where the tubercle bacillus rests as often as in the supraclavicular fossa, that pyramidal cavity in which are found deep cervical lymph nodes, which receive lymph from both head and lungs and are often tuberculous. It is admitted that these lymph nodes, in adults of civilized countries. are rarely markedly enlarged, as is the case in children or adults of primitive races, in whom Borrel found enlargement in 70 per cent of cases, as compared with 80 per cent for the hilar glands. However, microscopic examination (Harbitz, Ghon, Beitzke and others) shows tubercle bacilli present almost as often as in the hilar lymph nodes. What, then, might set up a mobilization of these bacilli, shut up in these nodes usually from childhood? Fraser, at Edinburgh, has noted in operations on these lymph nodes, that adhesions and periadenitis are frequently extensive, often involving the pleural dome and pulmonic apex. Likewise, in apical tuberculosis adhesions to the pleural dome are almost constant. Such adhesions may have served as a bridge for the transport of tubercle bacilli from the neck to the thoracic cavity. When tuberculosis of the supraclavicular lymph nodes and lung coëxists there may be doubt as to which was prior, especially in the adult, in whom conditions are almost always complicated. In the first place, these adhesions may often be due to nontuberculous infections, even though tuberculous lesions coexist. Koopman, in a series of 1,405 cases, estimates that in about one-third there is reasonable proof of tuberculous causation, about one-third are doubtful, and in about one-third there is no proof whatever. There are few reports of careful pathological studies. Even the normal lymphatic channels of the parietal pleura are not definitely known. On the other hand, clinical observations of extension from neck to apex are fairly numerous. Dental caries has been associated by a number of observers with the onset of clinical tuberculosis, and the coëxistence of the two conditions in the Faroe Islands has been recorded by Boeg. Sergent has noted supraclavicular lymphangitis in conjunction with apical pleuritis. When one presses behind the sternomastoid muscle one may determine sensitiveness of the whole chain of cervical lymphatics. Several interesting cases are cited of coexistence of active cervical and apical or pleural tuberculous lesions. It is concluded that up to the age of 10 the hilar lymph nodes play an important rôle in human tuberculosis, threatening the adjacent lung, the mediastinal and interlobar pleura. Later the cervical nodes assume a more important place and threaten the apical pleura and lung. True, the theory of a cervicopleural route has been condemned on the basis of histological anatomy, but pathological anatomy demands that our theories be revised.—*La voie pleurale (directe) de l'infection et l'exposition du sommet dans le réveil de la tuberculose pulmonaire, D. Reinders, Rev. d. l. Tuberc., June, 1928, ix, 372.*—(*A. P.*)

Transport of Tubercle Bacilli to Lymph Nodes.—It was shown in previous experiments that already one day after the intracutaneous injection of 0.01 mgm. of tubercle bacilli, the total extirpation of the site of injection does not prevent the development of generalized tuberculosis. In the present study an attempt was made to determine how fast tubercle bacilli reach the regional lymph nodes after infection. After some preliminary experiments, 8 guinea pigs were infected intracutaneously with 0.01 mgm. of tubercle bacilli, and an equal number were infected by cutaneous scarification. The heart's blood of these animals was injected intraperitoneally into other guinea pigs one-quarter, one, two, five, ten and twenty-four hours, and three and six days after injection. At the same time the regional lymph nodes were removed and injected subcutaneously into a guinea pig. In the animals which were infected by scarification tubercle bacilli were present in the regional lymph nodes one-quarter of an hour after the infection. The development of generalized tuberculosis occurred at a similar rate in all animals which received lymph nodes regardless of the interval between infection and removal of lymph nodes. In no case

did the heart's blood of infected animals produce generalized tuberculosis. In the latter animals the propagation to the lymph nodes occurs more slowly. Lymph nodes removed one-quarter and one-half hour after the infection did not produce tuberculosis. These experiments gave results similar to those reported upon infection with *Treponema pallidum*, spirochaetes of relapsing fever, and trypanosomes. It is important to note that tubercle bacilli are present in the lymph nodes long before clinically demonstrable swelling occurs.—*Über den Zeitpunkt des Eindringens der Tuberkelbacillen in die regionären Lymphdrüsen und in die Blutbahn bei cutaner Meerschweinchenimpfung, H. Martenstein, Klin. Wchnschr., January 22, 1929, iv, 159.*—(*M. P.*)

Lymphatic System of Lungs.—In the foetus the pulmonary lymph nodes develop at the bifurcations of the bronchi as well as at those of the blood-vessels. The microscopic intrapulmonary, peribronchial and perivascular lymph nodes, and those at the hilum and tracheobronchial bifurcation, and the interlobar and paratracheal nodes constitute an individual system regulating the lymph flow of the lungs. At the right as well as left hilum there lie a smaller anterior and larger posterior group of lymph nodes, which are between the bronchi and the blood-vessels and belong to both. The tracheobronchial nodes on the left follow neither the bronchus nor the pulmonary vascular stems, but rather lie directly on the aortic arch.—*Untersuchungen über das Lymphsystem der Lunge. Zugleich ein Beitrag zur Frage der Topographie der bronchialen Lymphknoten, R. Steinert, Beitr. z. Klin. d. Tuberk., 1928, lxviii, 497.*—(*H. J. C.*)

Diaphragmatic Excursions.—Fluoroscopic tracings taken in both lateral recumbent positions are of value in recognizing pathological conditions of the lungs, pleura and pericardium. Normally, the average excursion of the dependent half of the diaphragm in this series of cases was 6.3 cm., and of the upper half, 3.8 cm. The average difference in favor of the lower segment was 2.5 cm. Excursions of the upper leaf smaller than 2.5 cm., of the lower leaf smaller than 4.5 cm., or a difference between movements of the two segments of less than 1.5 cm. are to be considered pathological. However, when each one of the four measurements in a set exceeds 4.5 cm., the action of the diaphragm is to be considered normal. Normally, the brightest illumination of the lungs on inspiration occurs at the base of the dependent lung. Deviation from this represents lesions in the lung. When the excursion of one segment of the diaphragm is much restricted in both lateral positions, pleural adhesions on the side of the restricted leaf are indicated. When the movements of both sides of the diaphragm are much restricted in one lateral position and are normal in the other lateral position, this restriction indicates abnormality of the lower lung in the position showing the restricted movement. Normally the heart moves away from the dependent chest-wall on deep inspiration, the movement of the lower border of the heart shadow being greater than that of the upper border. In patients with adherent pericardium, this movement of the heart upward on inspiration is restricted or absent.—*Diaphragm Excursions, Normal and Pathologic, P. F. Butler and H. W. Dana, Am. J. M. Sc., October, 1928, clxxvi, 569.*—(*W. I. W.*)

Lipoids in Pathogenesis of Tuberculosis.—The important rôle of the lipoids in tuberculosis has long been recognized empirically and confirmed by the amelioration of morbid symptoms following the feeding of patients with substances rich in them. While it is true that tuberculosis develops rapidly in the obese this is explainable by the preponderance of saturated over unsaturated fats. Numerous statistics support the relation of tuberculosis to starvation, as during the World War in adults (Lubarski) and children (Stefko). Tuberculous processes developing under conditions of starvation invade all the organs, and result often in miliary tuberculosis. Goldenberg and Stefko have emphasized the iodine index and have observed a diminution of the quantity of unsaturated fatty acids in the starved and in the tuberculous. The reciprocal influence of the vital properties of the tubercle bacilli and of the chemical composition of the terrain deserves attention. The immunity of the horse to tuberculosis, the high sensitiveness of the guinea pig, the different manner of development in different organs or bodily organisms, may all depend on chemical relations. Of work on the effect of lipoids, that of Campbell and Kieffer on codliver oil and its effect on growth and acid-fastness is cited, and of Schöble on 42 kinds of animal and vegetable oils. Schöble found the most bactericidal to be oil of hydnocarpus (family *Flacourtiacae*), which inhibited growth in a concentration of 0.01 per cent. *Experiments:* Slabs of fresh sterile cow's fat were placed in sterile glass tubes. After adding physiological salt solution, two types of tubercle bacilli were planted, one growing quickly on glycerine-agar. Six weeks later this one had only begun to develop, and the colonies were punctate and

barely visible. In microscopic preparations were found decomposed acid-fast bacilli, violet granular forms, acid-fast granules and non-acid-fast bacilli. Lard gave the same results. The absence of albumin evidently led to death of the bacilli, as the same cultures on purée of potato with 10 per cent fat did not grow. In another experiment 5 per cent monobutyrin and tributyrin was added to potato-glycerine planted with two cultures, one fresh, the other well acclimated. Four weeks later the latter, planted on potato with the two kinds of butyrin added, yielded a very sparse culture, the former none at all. This appears to show but a feeble capacity for splitting synthetic fats. Next, experiments were carried out with pure fatty acids, in order to determine their bactericidal effects. Potato medium, cooked in physiological salt solution, was selected, the fatty acids being added while warm and the whole sterilized at 90°C. Five weeks after planting, the media containing 5 per cent palmitic acid showed a rather feeble punctate growth of the acclimated culture, and none of the other. The bacilli appeared thin, pale and macerated. There was no growth on 1 per cent or 10 per cent butyric acid, with or without glycerine, nor on 0.5 per cent to 4 per cent oleic acid. Scrapings from the planted surfaces showed acid-fast granular decomposition, and also non-acid-fast forms. The media containing 0.2 to 2 per cent gynocardic acid yielded similar results. Control cultures on 2 per cent glycerinated potato purée grew beautifully. The capacity of fatty acids, especially the unsaturated ones, for dissolving tubercle bacilli has been noted by numerous authors (Palma, Noguchi, Platonoff). A bactericidal effect of lecithin in cultures has been noted by Noguchi, Kondratovitch and others, and Platonoff has observed a heavy pigmentation of cultures. Cholesterin solutions, in concentrations of 0.03 to 0.5 per cent, appeared to exert an unfavorable effect. *Animal Observations:* Tubercle bacilli appear to develop with difficulty in organs rich in lipoids. Although glycerine, one product of fatty decomposition, is one of the best nutritive substances for the bacilli, the unsaturated oleic acid, which makes up a good part of the internal organs, is bacteriolytic, as are lecithin and cholesterin. Palma obtained unsaturated lipoids from cows' lymph nodes, which dissolved tubercle bacilli in a concentration of 0.001 per cent. Jaencin has found that cultures on oleic acid at 37°C. lose their acid-fastness in about a week and fail to tuberculize guinea pigs. The richness of horse-serum in oleic soap probably explains the immunity of these animals. *Tentative Conclusions: 1:* Fatty acids are not nutritive for tubercle bacilli; they arrest their growth in concentration of even 0.1 per cent. *2:* Lecithin has a bactericidal effect on tubercle bacilli and probably also cholesterin. *3:* There is no direct assimilation of neutral fats by tubercle bacilli. Glycerine must first be split off by the weakly acting lipase of the bacilli. Unsaturated fatty acids are bacteriolytic and weaken the virulence of the bacilli.—*Le rôle des lipoïdes dans la pathogénie de la tuberculose, G. Platonoff, Rev. d. l. Tuberc., August, 1928, ix, 561.*—(*A. P.*)

Alveolar Oxygen in Tuberculosis.—Recently respiratory function has been considerably studied, especially in the Anglo-Saxon countries, where notable work has been published on the composition of the alveolar air and relative proportion of gases in the blood. The carbon-dioxide content has been chiefly studied, oxygen less often. In the present study the oxygen in the alveolar air is measured by the eudiometric method. Reference is made to Haldane and Priestley's work in 1905 on alveolar air, and Dautrebande's determination of the partial pressures of oxygen and carbon dioxide in the arterial blood. Few studies have been made of the alveolar oxygen in the tuberculous, among the chief being those of Dautrebande, Meakins and Davies, and Hilton, on patients with artificial pneumothorax in Rist's service. Meakins, Davis ies and Dautrebande found a considerable variation, the highest partial pressures of oxygen being observed in those with most extensive lesions. *Technique:* Haldane's pyrogallic acid-absorption method was abandoned as too time-consuming and instead Gréhant's eudiometer was employed. The gas was collected in a test-tube graduated in cc. and a known quantity of hydrogen added; then the mixture was ignited by an electric current passing through a white-hot platinum loop, water being formed. After cooling, the new volume was read off and the quantity of combined hydrogen and oxygen determined; from this the oxygen was readily calculated. The apparatus, not at all complex, is described and illustrated. *Results: 1: Normal Subjects:* Several of these were found to show from 16.5 to 17 per cent alveolar oxygen, or 115 to 125 mm. mercury pressure. These figures are higher than the 13 to 14 per cent reported by Haldane and coworkers. *2: Tuberculosis, Slight and Inactive:* These subjects, 13 in number, averaged the same as the nontuberculous controls. *3: Tuberculosis, Lesions Extensive, Condition Poor:* Of 4 such patients, one showed a normal pressure, the others a definitely diminished oxygen content, around

13 per cent in two. *4: Tuberculosis with Progressive Exacerbations:* Six such patients all showed diminished alveolar oxygen, returning to normal during defervescence. One patient, in a state of dyspnoea, high fever and cyanosis showed figures as low as 10.3 per cent. *5: Pneumothorax-Treated Patients:* Five showed practically normal figures. One was a double pneumothorax, patient afebrile, doing well. *6: Fibroid Tuberculosis:* There were only 2 cases, one of which gave normal findings, the other diminished alveolar oxygen. *Discussion:* The alveolar-oxygen pressure or content seems not directly related to the clinico-pathological form of tuberculosis. It seems to be of some prognostic import, but its variations are less marked than those of carbon dioxide. Generally speaking, pulmonary disturbances provoke inverse variations of oxygen and carbon dioxide; in certain cases, however, they are simultaneously lowered, probably due to bulbar excitation; this secondary hyperventilation, however, fails to increase the oxygen content. Such hyperventilation seems due to the increased carbon dioxide rather than the anoxaemia. Artificial pneumothorax scarcely affects the alveolar oxygen at all. A simultaneous lowering of alveolar oxygen and carbon dioxide commonly accompanies progressive exacerbations. Modification of the blood and tissues of the tuberculous, making them less retentive of carbon dioxide, may be a factor. *Summary: 1:* Measurement of the alveolar oxygen by the eudiometric method is simpler and quicker than by the method of pyrogallate absorption. *2:* Such a measure is a good control of alveolar carbon-dioxide determination. *3:* Studies of the alveolar oxygen tension in pulmonary tuberculosis tend to confirm the results obtained by study of alveolar carbon dioxide tension. —*L'oxygène alvéolaire chez les tuberculeux, L. Bernard, Olivier and Thoyer, Rev. d. l. Tuberc., June, 1928, ix, 329.*—(*A. P.*)

Tuberculosis and Oxygen.—The aerobiasis of the tubercle bacillus is thought to explain numerous clinical observations, especially the predominant pulmonary involvement even though infection may originate in distant sources. Thus also is explained the predominance of tubercle bacilli in the walls of pulmonary cavities. On the other hand it throws light upon the sparsity and avirulent nature of those tubercle bacilli found in lupus and other forms of cutaneous tuberculosis. According to the author's experimental observations, the tubercle bacilli isolated from lupus are habituated to an environment low in oxygen. It is believed that individual types of tubercle bacilli show differences in their adaptation to oxygen. Human bacilli are accustomed to a good oxygen supply in contrast to the bovine bacilli. Many of the clinical symptoms of human tuberculosis are satisfactorily explained on the basis of these ideas.—*Allgemeines zum Problem Tuberkulose und Sauerstoff, L. Lange, Beitr. z. Klin. d. Tuberk., 1928, lxviii, 680.*—(*H. J.C.*)

Respiratory Reserve.—The object of this study was to determine the effect produced when sets of thoracic muscles were made functionless, either alone or with unilateral or bilateral paralysis of the diaphragm. A series of dogs was divided into four groups. In group 1 from 6 to 12 intercostal nerves were sectioned; in group 2 all intercostal nerves were sectioned; in group 3 the intercostal and phrenic nerves were sectioned; and in group 4 the spinal cord was severed. The following observations were made regarding the movements of the thoracic wall and the chest and of the costal arch: *1:* When intercostal nerves have been sectioned on one side the wall of the chest moves outward normally, but with limited excursional distance during inspiration. *2:* When the spinal cord has been transected the upper portion of the wall of the chest moves toward the midline during inspiration, this paradoxical movement was noticed in every animal and was similar to the movement of the chest at necropsy when the diaphragm is drawn downward. *3:* When the spinal cord has been transected the costal arches move outward normally and equally. *4:* When the spinal cord has been transected and one phrenic nerve severed the costal arches move outward normally and equally. In the animals in group 1 a portion of the intercostal muscles remained normal. These were proximal to the point of section of the nerve. At necropsy the first nerve was found intact in all the experiments and, therefore, the function of the first intercostal muscle had not been interfered with. All the muscles attached to the wall of the chest below the paralyzed muscles and to the head, neck and shoulders above them combined in the emergency to enlarge the thoracic cavity. The action of these muscles, alone or combined, was sufficient to overcome the tendency toward paradoxical movement when the diaphragm descended. Therefore, the thoracic wall moved outward with inspiration; the costal arch moved outward and the diaphragm descended at the same time. In the animals in group 4 the diaphragm did not have any muscular opposition either in the abdominal or thoracic

wall, and the costal arches moved outward through an apparently normal excursion. The only explanation that seems possible is that the increased pressure on the abdominal contents caused by the diaphragm's contraction forced the arch outward. Observations already mentioned showed that the outward movement of the costal arch and the wall of the chest whose muscles were intact was bilaterally equal even when half of the diaphragm was paralyzed. This is true after phrenic neurectomy in man as well as in the dog. In the latter the measurements can be taken before killing by overetherization after stripping the costal arch of all superficial structures, the visible movement and the measurements are, then, not confounded and confused by the overlying integument. In the animals in which the spinal cord was transected and one phrenic nerve cut the contraction of the hemidiaphragm was not associated with decreased movement of the costal arch on that side. Therefore, the pressure on the abdominal contents must have been distributed equally in all directions. Only such pressure could have caused a paralyzed chest to move outward as if taking active part in inspiration.—*Efficiency of the Mechanical Factors of Respiration. A Study of Respiratory Reserve, W. S. Lemon, Am. J. M. Sc., March, 1929, clxxvii, 319.*—(*W. I. W.*)

Blood Groups and Tuberculosis.—Observations were made on the blood-grouping of 564 persons ill with pulmonary tuberculosis and compared with similar observations of a large number of healthy subjects. The classification was essentially alike in the two sets of people. More very ill patients fell into groups I and more slightly or moderately ill patients into group II.—*Ueber die Häufigkeit der einzelnen Blutgruppen bei Lungentuberkulösen, P. A. Schmitt, Deutsche med. Wchnschr., November 30, 1928, liv., 2019.*—(*H. S. W.*)

Exudates and Parathyroid Hormone.—The present study was undertaken to determine whether the parathyroid hormone will prevent the formation of experimental effusions. Sixteen experiments were performed on dogs. Seven animals were used for control experiments. The results indicate that the parathyroid hormone (Collip), given subcutaneously, diminishes or prevents pleural effusions following the intrapleural injection of an irritant (solution of copper sulphate). In the dog it appears that considerable hypercalcaemia is necessary, because the animal (number 9) that had a relatively low serum-calcium behaved practically the same as the normal control animal in response to the irritation. The observation that certain doses of the parathyroid hormone inhibit experimental exudates produced by a given kind and degree of irritation has interesting clinical possibilities. To what extent it will prove applicable for the prevention of clinical effusions remains to be determined by direct observations. Its usefulness will almost certainly be limited by such factors as the cause of the effusion, the intensity of the irritation, the degree to which the hormone will produce hypercalcaemia in man without toxic symptoms, and the degree of hypercalcaemia necessary in man to impair the passage of fluid from the circulation into the tissues or body cavities.—*The Prevention of Experimental Exudates by the Parathyroid Hormone (Collip), H. Gold, Arch. Int. Med., October, 1928, xlii, 576.*—(*W. I. W.*)

Thoracic Puncture Fluids.—Thoracic puncture fluids may be divided into the following classes: (1) Serous exudate, (2) hydrothorax or transudate, (3) hydro- and pyopneumothorax, (4) haemothorax, (5) haemorrhagic effusion, (6) empyema, (7) very rare conditions, such as chylous effusion, hydatid cyst, etc., and (8) lung puncture. The commonest variety of serous exudate is the simple pleural effusion which in the majority of instances is tuberculous in origin. Hydrothorax is the most typical example of the transudate occurring in chronic valvular disease. It is common knowledge that pneumothorax, whether spontaneous or induced, is often followed by an effusion of fluid into the pleural sac. In spontaneous pneumothorax at least four varieties of fluid may be recognized: (1) Serous, (2) seropurulent, (3) purulent, and (4) septic. Haemothorax may arise from a lesion of the lung or some neighboring organ, as in aneurysm, and from some general blood disease, as in scurvy.—*Thoracic Puncture Fluids, S. R. Gloyne, Tubercle, November, x, 53.*—(*W. I. W.*)

Pleuritis and Water Balance.—The origin and disappearance of pleuritic exudates are independent of the total water balance, and depend on the local disease process. The water balance in a fresh pleuritis is negative. Neither the dehydrating measures nor sodium-chloride-poor diets or diuretics tend to prevent the development of the effusion. Dry diet and diuresis can only exert an influence in the stage of resorption but do not cause dehydration. In the presence of secondary circulatory disturbances, agents influencing oedema are without

effect upon the exudate.—*Pleuritis und Wasserhaushalt, W. Nonnenbruch, Zeitschr. f. Tuberk., 1928, l, 193.*—(*H. J. C.*)

Laboratory Investigation of Tubercle Bacillus.—The usual morphology and staining reactions of the bacillus are epitomized and the fact noted that these are influenced by the chemical composition of the culture media. The transmutation experiments of Vaudremer, Bezançon and Philibert, Valtis, Fontés and others are referred to, including so called filtrable forms, also Arloing and Dufour's reported studies on intrauterine transmission from a phthisical mother to a premature child. Some observations of Couvelaire in the tuberculosis annex of Baudelocque's obstetrical service are cited, covering 100 children or foetuses expelled from 99 women, of whom 15 were premature, stillborn or died shortly after birth, and 85 living and viable. Including 6 more who died in the clinic, there were 21 dead infants or foetuses to study, of whom 10 came to necropsy. In one case cited, in which there was no visible lesion, guinea-pig inoculation showed the liver, spleen and lymph nodes virulent, although revealing nothing on direct examination. Couvelaire cites a number of cases of progressive denutrition ending in death in which filtered organs bacillized guinea-pig lymph nodes. Certain filtrates appear to produce only a transient tuberculin allergy. For studying the evolutionary phases and morphology of the bacillus Dascotte recommends Petroff's medium. Characteristic implantation colonies usually appear in about three weeks. A glycerinated medium (4 per cent) containing asparagin and certain salts is also employed, and Dascotte claims to have developed strains which will grow in twenty-four hours on most of the common media, the adipocirrose envelope being lost and reappearing when retransplanted to the depths of solid media. Acid-fastness is generally lacking in cultures on liquid media, but is made manifest on Petroff's medium, glycerinated potato and glycerinated serum. Old cultures develop "chromophile corpuscles" and spores. *Complement-Deviation Reaction:* Besredka's technique is used, 0.2 cc. of patient's serum with 0.5 cc. of bacillary emulsion. *Searching Sputum:* Ziehl-Neelsen's and Hermann's stains are used. When there is a chance of confusion with other acid-fast bacilli, a very rigorous technique must be followed, at least ten minutes being allowed for colorization, two for the nitric acid decolorization, and 5 for absolute alcohol immersion. When direct examination is repeatedly negative homogenization and enrichment should be resorted to, the latter by incubating tubes of sputum for two or three days at 50°C. in order to liquefy, autolyze and precipitate the bacilli. In young children who do not expectorate, gastric lavage in the morning shortly after coughing will often reveal bacilli. Administration of an emetic, as ipecac, may serve a similar purpose. When bacteriological examination remains negative, animal inoculation is indicated. Freshly expectorated sputum is washed in physiological salt solution and injected subcutaneously in the upper thigh of a guinea pig. Peritoneal inoculation will kill the animal in a few days by setting up an acute septic peritonitis from the accompanying pyogenic organisms. Some inflammatory reaction at the site of inoculation is to be expected for the same reason. If, however, tubercle bacilli are present, the inguinal lymph nodes on that side begin to be palpable after about two weeks and increase gradually, suppurating if the bacilli are numerous and virulent. These local reactions are followed by a general invasion, first of the pelvic, lumbar and intestinal lymph nodes, then spleen and liver, and finally the lungs. If the animal wastes despite good feeding one may kill it at the end of a month; otherwise, after eight to ten weeks. The spleen is generally characteristic, with granulations or caseous gray-white foci. One may diagnose tuberculosis only if acid-fast bacilli are recovered from the lesions, as pseudotuberculosis may manifest itself by the presence of nodules in the liver and swelling of the mesenteric lymph nodes. The pus expressed from such lesions is more fluid and usually contains a coccobacillus, gram-negative. When guinea pigs are not available pathological products may be cultured, Petroff's medium being the best. In searching for tubercle bacilli in the urine, care must be used in staining and decolorizing in order to avoid confusion with other acid-fast bacilli. Serofibrinous exudates must usually be inoculated to demonstrate bacilli and should first be defibrinated, either by shaking with glass beads or adding sodium-citrate solution, and then centrifugating for some time. In the case of stools, glairy particles are picked out with a platinum loop and stained carefully as in the case of the urine; or Veriot and Moreau's homogenization technique may be used: a grain of stool is triturated, adding little by little a 25 per cent aqueous sodium-chloride solution to make a semiliquid emulsion, which is filtered through sterile gauze and centrifugated, after which are added to each tube 2 cc. of a mixture of equal parts sulphuric ether and ligroin; this is centrifugated ten minutes and from under the upper ethereal layer a brownish cake is

removed, which will contain the bacilli if present. The blood is rarely examined for tubercle bacilli, as they are scarcely present in the blood-stream except in acute miliary disease. To find them, 20 cc. of blood must be taken from a vein, mixed with 200 cc. of water and centrifugated. *Cytological Examinations:* The sputum of ordinary fibrocaseous tuberculosis differs little from that of common bronchitis. There are usually many polynuclears and lymphocytes or mononuclears also if there is an alveolar reaction. During periods of caseation mononuclears are always present and there are also many degenerated elements. The presence of elastic fibres means ulceration, resulting from abscess, gangrene or tuberculosis, but they rarely precede the appearance of bacilli. Serous exudates should always be studied cytologically, coagulation being prevented by shaking with glass beads or adding a few cc. of 10 per cent sodium citrate. So called primary pleural tuberculosis shows a characteristic cytology: at first there are seen desquamated endothelial cells, polynuclear neutrophiles, sometimes eosinophiles and red blood cells, and lymphocytes in the proportion of 10 to 40 per cent; after about a week, however, the lymphocytes predominate. In pleurisy secondary to pulmonary tuberculosis the exudate is less fibrinous, rich in polynuclear neutrophiles, and only shows predominance of lymphocytes in cases progressing toward cure. Pleurisies in the course of artificial pneumothorax rarely show a marked lymphocytosis; if they become purulent, as frequently they do, a polynucleosis is the rule. In general, nevertheless, one may say that serous reactions to tuberculosis manifest a lymphocytosis, to pyogenic infections a polynucleosis, and to mechanical irritation an endothelial desquamation. The cerebrospinal fluid may be studied cytologically, from a quantitative viewpoint by Nageotte's microscopic cell, qualitatively by centrifugating and staining. In tuberculous meningitis the fluid is characteristically clear, the number of cells increased to from 15 to 1000 per cmm., as contrasted with a normal count of 2 or 3. Lymphocytes predominate, usually 95 to 99 per cent. Lymphocytosis may, however, also occur in the meningeal complications of mumps, measles, zona, influenza and syphilis, so that search for tubercle bacilli, the Wassermann reaction and certain chemical tests are also required. *Serological Diagnosis:* The complement-fixation reaction has been found positive in 85 to 90 per cent of bacillary tuberculous cases, but unfortunately fails too frequently where most needed. Verne, of Paris, has introduced a flocculation reaction, in which a resorcin solution is added to human serum, and the degree of flocculation measured by a photometer. One adds 0.6 cc. of unheated serum to the same quantity of double-distilled 25 per cent resorcin solution. Jacquot and Uffoltz, having performed 6,000 flocculation tests in two tuberculosis dispensaries, believe there is a direct relation to the degree and activity of tuberculous infection and that it is a more highly sensitive test than the complement deviation. It seems that it might well be added to the diagnostic armamentaria of our sanatoria.—*Biologie et procédés de recherche du bacille de Koch, Dascotte, Rev. Belge d. l. Tuberc., March-April, 1928, xix, 49.*—(*A. P.*)

Metabolism of Tubercle Bacillus.—On the basis of the oxygen and carbon-dioxide requirements of the tubercle bacillus it is believed that the multiplication of this microörganism in the body can be dependent upon the source of energy. The disposition of the diabetic to tuberculosis can be explained on the basis of an abnormal intermediate product being formed in the carbohydrate breakdown which serves as an energy source for the tubercle bacillus. The oxygen requirement of the tubercle bacillus in cultures is not necessarily the same as that in the body. It is believed to be dependent more upon the substrat energy source. It is possible that the tubercle bacillus is aided in the body by various oxidation-reduction reactions. The cultural oxygen requirements of the tubercle bacillus, as well as the carbon-dioxide requirements, need not obtain in the body. Only clinical observations and animal experiments can determine whether an alternating oxygen and carbon-dioxide tension exerts an influence upon tuberculosis.—*Der Stoffwechsel des Tuberkelbacillus in seiner Abhängigkeit von Sauerstoff und Kohlensäure, O. Kirchner, Beitr. z. Klin. d. Tuberk., 1928, lxviii, 708.*—(*H. J. C.*)

Inhibiting Action of Blood on Tubercle Bacilli.—In order to investigate the effect of chemotherapeutic agents the author used the Wright method of whole blood incubated for 14 days in capillary tubes. The strains of tubercle bacilli utilized grew well in guinea-pig blood but not equally well in the entire column. At the end of the capillary blood column, where access to air was best, the colonies grew most satisfactorily. A variable inhibition and intensity of growth, dependent upon the source of blood, was noted. The cultures to be tested should be no older than 4 to 6 weeks. The author tested 300 chemical substances, with more than 20 different chemical groupings, for bactericidal action

toward tubercle bacilli. The ordinary antiseptics, such as mercuric chloride, alkalysol, *Tusputol*, chloramin and phenol possessed no inhibitory action in 1:12,000 dilutions. For the quantitative determination of bactericidal action the entire blood thread must come in contact with oxygen, and for this purpose the specimens were placed upon cover-glasses and incubated in a moist chamber, after which the colonies were counted at 10-day intervals. The variations in the different strains of tubercle bacilli were tested, and it was found that with a normal guinea-pig blood 8 of 11 gave equal values; normal rabbits also revealed only slight deviations from normal, and paralleled the findings with guinea-pig blood while with human blood only half of the cases gave corresponding findings, which is attributed to the presence of tuberculous infection in man. A variation in human blood also occurred at different periods of examination. The blood of tuberculous guinea pigs and rabbits was found to contain specific inhibiting substances in variable amounts. In scorbutic guinea pigs the bactericidal action was markedly depressed. —*Bactericide und entwicklungshemmende Wirkung des Blutes auf Tuberkelbacillen. I.: Eine neue Methode zu ihrer quantitativen Messung, Gertrud Meissner, Centralbl. f. Bakt., Abt. I, Orig., 1928, cvi, 210.*—(*H. J. C.*)

Cultivation of Tubercle Bacilli from Circulating Blood.—A brief review of the data on tubercle bacilli in the blood and of methods for determining this by direct microscopic examination and animal tests is given. These methods have yielded variable results. The author's method consists of placing the blood in 15 per cent gelatine or 20 per cent peptone Ringer's solution, after which the sediment of blood corpuscles is grown upon an egg medium. In 43 cases thus examined three positive findings were obtained.—*Direkte Züchtung von Tuberkelbacillen aus dem strömenden Blut, K. Bingold, Beitr. z. Klin. d. Tuberk., 1928, lxviii, 734.*—(*H. J. C.*)

Demonstration of Tubercle Bacilli in Cerebrospinal Fluid.—The following technique has been found very satisfactory in hospital service: *1:* Into a centrifuge tube is placed 4 to 5 cc. of spinal fluid, heated to 70 or 80°C., and 2 cc. of one-third strength trichloracetic acid is added. The whole is slighty heated and centrifugated twenty minutes after cooling. *2:* The centrifugated sediment is stained in the usual way, several slides being made, and carefully examined. The bacilli are caught in the albuminous deposit and may be discovered in 80 per cent of cases—*Technique pour la recherche du bacille de Koch dans le liquide céphalo-rachidien, M. Mathieu, Section d'études scientifiques de l'Oeuvre de la Tuberculose, November 12, 1927, reported in Rev. d. l. Tuberc., February, 1928, ix, 73.*—(*A. P.*)

Viability of Tubercle Bacilli in Septic Tank.—Guinea pigs were inoculated with the effluent material from the septic tank that served a hospital for consumptives. These animals died of acute generalized tuberculosis. Cultures revealed a virulent tubercle strain which grew luxuriantly on glycerine media. These findings are reported because some hospitals for the tuberculous may dispose of the sludge of septic tanks on land used for gardens or for grazing. This form of disposal must be regarded as questionable in view of the above results. —*Living Tubercle Bacilli in a Septic Tank Effluent, S. L. Cummins, Tubercle, April, 1929, x, 310.*—(*W. I. W.*)

Experimental Pathogenicity of Avian Tubercle Bacillus.—It is only recently that the avain tubercle bacillus has received much attention from investigators in the field of tuberculosis. This is probably due to the fact that the avian bacillus is generally believed to be only slightly pathogenic for mammalia. Isolated instances of spontaneous infection in man have been reported, however, and the majority of these cases were characterized by a septicaemic type of disease. One of these resembled the Pel-Ebstein form of Hodgkin's disease. Cases of myeloid leukaemia have been described from which the avian tubercle bacillus was isolated, and in which the avian infection appeared to be located in the bones. Hirschfield claims that avian tuberculosis and the leukaemias have an identical aetiology. That avian tuberculosis has a definite predilection for bones is thoroughly established in the literature. It has been suggested that the marked disturbance in the function of the marrow (and spleen) may account for leukaemia and polycythaemia in leukaemia. Among the lower mammals in which a spontaneous avian infection is most frequently encountered, swine occupy the first place. These animals develop a fatal nodular tuberculosis, involving the lymph nodes, usually the mesenteric, and they become infected by feeding on tuberculous chickens. Bang and others report that the common mesenteric-node tuberculosis of swine is practically always of avian type. Primary avian infection has been reported as occurring occasionally in horses, dogs, cats and rodents. Most of the spontaneous avian

infection in animals falls into two main groups; first, those affecting extensively the lymph nodes, with lesser lesions in liver and spleen, and, second, an acute septicaemic form, as described by Yersin. In experimental infection rabbits appear to be most susceptible. These animals, when inoculated intravenously, develop a septic (Yersin) type of the disease, characterized by a generalized septicaemia, with few definite tubercles, to which they succumb in from fourteen to twenty-one days; on the other hand, subcutaneous inoculations into rabbits produce only local lesions from which the animal usually recovers. Next in susceptibility are mice, to both intraperitoneal and subcutaneous injections. Monkeys are resistant to avian infection, but may develop local abscesses. The guinea pig is relatively immune to avian tuberculoiss, but when the inoculation is made intraperitoneally generalized disease may develop. With the idea that the aetiological factor in Hodgkin's disease might be an atypical form of tubercle bacillus or a peculiar reaction to one of the known forms of these microörganisms,the possibility suggested itself that in otherwise resistant mammals a susceptibility to the avian bacillus might be induced or heightened by a previous inoculation with killed bacilli of the human or bovine types. As a preliminary test of the concept, three guinea pigs were injected subcutaneously in the groin with 1.0 mgm. of killed human tubercle bacilli suspended in 1.0 cc. of physiological salt solution. Two other guinea pigs received a similar dose of killed bovine tubercle bacilli, and three were inoculated subcutaneously with a live avian culture (dose not mentioned). One animal was left uninjected. The bacilli were killed by heating the suspensions for one hour on three consecutive days at 90°C. Eight days later, the 8 animals receiving the above preliminary injections were given 1.5 cc. of a thick suspension of live avian bacilli and this injection was repeated seven days later. All the inoculated guinea pigs developed local lesions in the groins. In the group receiving live avian suspension only, the local lesion was transitory and had healed completely within two weeks. Two of these animals are dead and only one (after 253 days) revealed any evidence of tuberculosis, showing a well walled-off area of necrosis in the liver, but no other lesions. These results indicate the nonvirulence of this particular avian strain. The two guinea pigs receiving killed bovine tubercle bacilli and reinjected with avian bacilli, developed a more persistent and active local lesion, which however eventually healed in about four weeks. Both animals later died (150 and 163 days respectively) from acute infection following parturition. In the group receiving the combination of killed human and live avian tubercle bacilli, the local lesion was most intense, eventually resulting in large indolent ulcers. There were also fever and loss of weight. One died 112 days after inoculation, and at autopsy showed enlargement of inguinal, mesenteric, retroperitoneal and bronchial lymph nodes, with little or no involvement of the lungs, and with extensive infarcts of liver and spleen. The second and third animals died within this period, and both showed similar changes in the organs and lymph nodes. Microscopically these animals showed a peculiar condition, consisting in a predominance of large epithelioid cells, numerous myeloid giant cells of the Sternberg type, and no Langhans giant cells or typical caseous necrosis. This picture appears to be practically identical with Hodgkin's disease with the exception of the absence of the eosinophiles. The inoculated animal is still alive. This experiment was repeated on a somewhat larger scale, in which the dose of avian suspension was modified and controls were added and inoculated with killed cultures of each type only. This was done to eliminate the possibility of a few human or bovine tubercle bacilli surviving the heating and producing lesions, and also to determine whether or not generalized infection might not be induced by the injection of killed microörganisms. For the second experiment 14 guinea pigs were used, 6 receiving heat-killed human and 6 heat-killed bovine bacilli. Four weeks later four of each group received 1.5 cc. of live avian-bacilli suspension, two of each series serving as human and bovine controls. Two of the original fourteen guinea pigs received 1.5 cc. of avian suspension only, to serve as controls of the virulence of the avian culture. One of these last controls died of an uncertain cause (apparently not tuberculosis) and the other is still alive. The group receiving the combination of killed bovine and live avian tubercle bacilli presented practically the same pathological changes that were seen in the preliminary experiment. This group also suffered from puerperal septicaemia. Of the 2 bovine controls one was found normal at autopsy (345 days) and the other is still alive. The results obtained in the human and avian series were similar to those of the same combination on the first experiment. The infection in the second series was not so intense as that in the first; this was due probably to the fact that in this series only a single avian inoculation was made, as contrasted with the two inoculations in the first series. Hence, the duration of life in the

second series was considerably longer. The killed human-bacilli control group gave negative results. In fact, none of these heat-killed-bacilli controls died spontaneously, and those killed did not show any gross or microscopic lesions at autopsy. *Conclusions:* The results obtained seem to indicate that it is possible to transform an animal relatively resistant to the avian tubercle bacillus into a more or less susceptible one by previous treatment with heat-killed human tubercle bacilli. The consistent difference in the type of infection observed in the animals previously treated with killed human strain and those treated with the killed bovine tubercle bacilli seems to indicate a difference in the preparatory influence of these two strains. However, the presence of puerperal septicaemia in the bovine series makes the interpretation of the findings in this series doubtful and calls for further investigation.—*The Pathogenicity of the Avian Tubercle Bacillus, Elise S. L'Esperance, J. Immunol., January, 1929, xvi, 27.*—(*J. S. W.*)

Bovine and Avian Tuberculosis in Man.—It is firmly established that bovine tubercle bacilli may be a potent cause of illness and death of human beings. It is probably true that 25 per cent of all the tuberculosis of children and about 5 per cent of all tuberculosis is of bovine origin. Until a satisfactory method for determining which of the reacting cattle are a menace to consumers of milk, the only safe method of protection is that of withdrawing all reactors from the herd. As to avian tubercle bacilli, not so good a case can be made out Numerous writers have reported human disease produced by avian tubercle bacilli, but final judgment must rest upon further careful observation.—*The Danger to Man of Bovine and Avian Tuberculosis, C. H. Mayo, J. Am. Vet. M. Ass., September, 1928, lxxiii (n.s. xxvi), 653.*—(*H. S. W.*)

Studies on Tuberculin.—*1: Effect of Various Normal and Antituberculous Sera on Tuberculin:* In a previous paper it was shown that the appearance of tuberculin reactions, general, focal or local, depends on the existence of an allergic state ordinarily created by tuberculous infection and that intensive tuberculin treatment of healthy subjects (noninfected) provokes no sensitization or antibody formation. On the other hand, if tuberculous subjects are judiciously selected and prudently treated with increasing doses of tuberculin it is finally possible to inject considerable amounts without appreciable disturbance. A tolerance for this product is established. Although many hypotheses have been put forth to explain these facts, that of Nicolle, adopted by Wolff-Eisner, in which a lysin of tuberculous endotoxin is assumed to intervene, setting free some substance which provokes inflammatory response, seems best to fit the facts. Many workers have studied the influence of contact with sera on the activity of tuberculin, and recently Salomon and Valtis have published their results, with these conclusions: *1:* A mixture of tuberculin and antituberculous serum does not affect healthy rabbits. *2:* Skin reactions provoked by such mixtures vary, sometimes being stronger, sometimes weaker, than with tuberculin alone. *3:* Normal serum diminishes the intensity of such reactions. De Potter's studies of the cuti- and intracutaneous reactions were on tuberculous subjects. The sera were obtained from persons affected with various forms of tuberculosis, and in various stages of the disease and various degrees of allergy or energy. Crude tuberculin was used, diluted 1–10, 1–100, or 1–500 in pure serum, prepared an hour in advance. Cutireactions to 50 per cent tuberculin in glycerine served as controls. No person with a negative reaction to tuberculin gave a positive on addition of serum. The intracutaneous test consisted of the intracutaneous injection of 0.1 cc. of tuberculin diluted 1–10,000 in the serum. In 22 subjects the mixtures of tuberculin and unheated serum, left in contact ten minutes, gave 10 reactions analogous to the controls with tuberculin alone, 9 stronger and 3 weaker. Of 19 subjects injected with mixtures of tuberculin and heated serum (56°C. for 30 minutes) 7 showed similar reactions, 8 weaker and 4 stronger. Of 20 subjects inoculated intracutaneously with 0.05 or 0.1 cc. of unheated serum and in another place with 0.1 cc. of 1–10,000 tuberculin, 10 reacted similarly to both substances, 6 more strongly to the serum and 4 more strongly to tuberculin. Of 20 patients so treated with heated serum and tuberculin, 3 gave similar reactions, 14 feeble or negative with the serum, and only 3 stronger than the corresponding tuberculin reaction. It is noted that in the intracutaneous reaction with pure serum the hyperaemic zone is similar to that in the tuberculin reaction, but the oedematous infiltration is lacking and very seldom is a central papule observed. If horse serum instead of human serum is used, the reactions appear to be the same, whether the serum comes from a normal horse or one with a high antibody titre due to previous artificial immunization. Normally tuberculous subjects are much more sensitive to horse serum than to human serum. *Reactivation of Tuberculin Reactions:* One must distinguish between true

revivification or reactivation of a tuberculin reaction and later reactions due to serum sensitiveness. The unheated serum of tuberculosis patients evidently possesses a more marked activating property toward tuberculin than does heated serum. Prolongation of contact beyond ten minutes lessens the difference. If there occurred a true neutralization, antituberculous horse or human serum ought to act differently from normal serum. Neither allergic nor anergic sera exert any appreciable effects *per se* on the mixtures. Moreover, there is no parallelism between the antibody content of the sera and the intensity of the individual cutireacton. *2: Homeotopic and Heterotopic Sensitiveness to Nonspecific Protein Provoked by Tuberculin:* It has been remarked that the tuberculous subject may react to intracutaneous injections of human or horse serum or highly dilute protein products, although scarification tests with these substances are almost never positive. Again, in the tuberculous, the intracutaneous injection of tuberculin creates a hypersensitive zone within which later cutituberculizations provoke earlier and more intense reactions. Pirquet early observed this, and Coulaud has observed that 30 per cent of subjects present a positive cutireaction with a "paratuberculin" (extract of cultures of dung or Timothy bacillus) when the first test with this latter was negative. De Potter has carried these studies further by practising cutireactions on the cicatrices of former positive reactions, using tuberculin and various nonspecific substances, among them "fleolin" and mallein. The tests were carried out before the local manifestations of previous intracutaneous reactions had disappeared, that is, between eight and twenty-one days after the tuberculinization. Like all cutireactions, these secondary tests were made with a linear incision in the centre of the cicatrix, accompanied by a control reaction on new skin (heterotopic). Clearly positive reactions were characterized by redness and odematous infiltration. Such were obtained with glycerinated peptonized bouillon and with nonpeptonized bouillon. To peptone water about 50 per cent reacted postively in the cicatrix. Of 10 such cutireactions done with fleolin, 9 were positive only homeotopically, 1 showed the same reaction as the control. Mallein did not seem to cause any reaction. Tuberculin itself induced enormous homeotopic reactions, appearing early and reaching an acme in twenty-four hours; the central papule was violaceous and painful, accompanied by much surrounding infiltration and often by a spreading lymphangitis. Next cutireactions were carried out on the cicatrices of nonspecific intracutaneous reactions. Here the homeotopic reactions (cutireactions) were nearly aways rather strongly positive, the heterotopic negative, using serum, bouillon concentrated or without peptone, and peptone water; fleolin again failed to cause a local reaction. Tuberculin cutitests on nonspecific cicatrices were found to be regularly positive but less pronounced than homeotopic reactions, and to appear rather early, reaching the acme in eight or nine hours, and disappearing entirely within forty-eight hours. Revivification of distant tuberculin cutireactions, described by some, was never observed by De Potter in the course of numerous repetitions of tests. *3: Experimental Modification of Allergic State in Guinea Pigs:* The relative specificity of the tuberculin cutireaction in man and intracutaneous reaction in the guinea pig being recognized, proof must be sought that no artificial factor could create or make disappear such allergy. It has recently been found that the actual presence of living tubercle bacilli is not a *sine qua non*, also that the cutireaction may disappear during influenza, measles, whooping cough, the catamenial period, pregnancy and parturition; also typhoid fever and certain pneumopathies. The action of iodides has also been reported. Sorel, in tuberculous guinea pigs, noted strong febrile reactions and generalization of the tuberculous infection with changes in the leucocytic picture in the blood. A certain tolerance may be established, not identical with that for tuberculin. De Potter used various iodide salts in tuberculous guinea pigs, injected in various ways. Sodium and ammonium iodide appeared to have less effect on later tuberculin reactions than potassium iodide, and those animals treated intracutaneously showed the most marked reactions later in cutituberculin tests. Subcutaneous injections appear to have an antiallergic effect on local tuberculin reactions, but general reactions appear to be more pronounced. *4: Sensitization of Healthy Guinea Pigs to Tuberculin:* Although some workers have reported such a sensitization by the skin route, and Calmette and coworkers obtained a positive ophthalmic reaction in a rabbit six hours after the intravenous injection of tuberculin, most reports are negative, as were all the attempts made by De Potter. Reference is also made to experiments attempting immunization by means of pig serum combined with tuberculin, based on an ephemeral tuberculin sensitiveness observed to occur following intracutaneous injections of the tuberculin serum mixtures. These ephemeral reactions may, however, depend on some protein impurity in the tuberculin and should be checked by

the use of albumin-free tuberculin. Horse and guinea-pig serum, and filtered tuberculous lung pulp, nevertheless do not give rise to the positive reactions noted with the use of pig serum, which must possess peculiar antigenic properties. Neither the pig serum nor tuberculin alone will induce these reactions. *Conclusions: 1:* The complement-fixation reaction is not a specific measure of tuberculin activity, in view of the more or less antigenic properties of certain culture media and of certain paratubercle bacilli, deprived of toxicity. *2:* The specificity of the precipitation or flocculation reaction is not established and this has also no relation to tuberculin activity. *3:* Pirquet's cutireaction may be regarded as specific in tuberculous subjects and is a very good index of tuberculin activity. *4:* The intracutaneous reaction in the human subject is not absolutely specific, as certain similar reactions may be noted from serum or constituents of bouillon, but their evolution is different. *5:* The intracutaneous reaction in the tuberculous guinea pig is specific. Healthy animals never react to tuberculin and tuberculous animals only feebly to "fleolin" and never to nonspecific products. *6:* The addition of serum to tuberculin has a variable effect, depending on the sensitiveness of the individual to this substance. *7:* Tuberculin cuti- and intracutaneous reactions and intracutaneous reactions to nonspecific products provoke a local sensitiveness, most marked homeotopically. *8:* Subcutaneous repeated injections of potassium iodide modifies the allergic state, causing attenuation of local tuberculin reactions; this is less marked with other iodides. *9:* Artificial sensitization of guinea pigs to tuberculin is possible by subcutaneous or intracutaneous injection of mixtures of tuberculin and pig serum, which must be fresh. *10:* A tuberculin titered on a tuberculous guinea pig may manifest different toxic or antigenic properties for cattle or for man.—*Sur les propriétés antigènes et réactionnelles des Tuberculines, F. De Potter, Rev. Belge d. l. Tuberc., March-April, 1928, xix, 60.—(A. P.)*

Critical Analysis of Ferran's Anti-Alpha Vaccine.—According to Ferran's assumptions, the tubercle bacillus, which he designates as the "gamma" form, is only a transitory form of a parasitic cycle, of which there are also "alpha," "beta," and "delta" forms. The so called "alpha" bacilli consist of non-acid-fast rods, ordinarily gram-negative, mobile and easily cultivated on ordinary media. Old bouillon cultures exhale a fine odor, barely perceptible. The "alpha" bacilli do not sensitize to tuberculin but may deviate the complement of tuberculous sera. They are omnipresent in the living body and abundant in nature, causing haemorrhagic septicaemia, typhoid and paratyphoid fever, and colon bacillus infections, as well as tuberculosis. Injected into guinea pigs, they set up local inflammatory oedema, lymph-node reactions, visceral degenerations, rapid death or progressive cachexia, or tuberculous lesions. The "beta" bacilli are an intermediary form between the above and the "gamma" (tubercle) bacilli. Transmutation occurs only in one direction. However, Ferran has also described "delta" and "epsilon" bacilli which complete the cycle in regressive or descendant series. The former resemble "gamma" bacilli, but are less virulent and can be emulsified by shaking in glycerine-bouillon. The "epsilon" bacilli, on the other hand, are gram-negative, mobile and non-acid-fast, not possessing the specific characters of tubercle bacilli. This last cycle, Ferran states, may be reversible. *Study of "Anti-Alpha" Vaccine:* It was decided to determine (1) the quality and quantity of living organisms contained, and (2) their relation to the colon-typhoid group. Thirty ampules were examined, from diverse pharmacies, also ten from the Ferran Institute at Montevideo. They all showed identical contents. The results are summarized as follows: *1:* Ferran's "anti-alpha" vaccine contains various living microörganisms, among them two spore-forming bacilli, a facultatively aerobic micrococcus and a probably strictly anaerobic coccobacillus. *2:* None of these has any demonstrable relation to the colon-typhoid group. *Analysis of Vacarezza's Statistics:* These refer to 687 children, aged 3 months to 3 years, vaccinated at the Hôpital des Enfants-Déposés at Buenos-Aires, between June 1, 1920, and February 28, 1922. Only 377 were said to have had complete dosage of 3 cc., and of these 4 died of tuberculosis, a proportion of 1.06 per cent. However, inspection of the records reveals that 4 more died who had received 2.75 cc. If these were included, and there seems no sufficient reason for excluding them, we have a figure of 2.12 per cent, to be compared with previous figures for 1918–1920 of 3 to 3.78 per cent. Such a slight diminution may easily be fortuitous. Among children born of tuberculous mothers and promptly isolated (62), the mortality was 8.03 per cent, compared with Bernard and Debré's figures of 7.60 per cent, no significant difference. Also, among Vacarezza's series were 20 children dead of pulmonary diseases clinically classed as non-tuberculous, but not autopsied. Arena, in experiments with cattle, reported entirely negative results with Ferran's vaccine. *Conclusions: 1:* The characteristics attributed

by Ferran to the "alpha" bacteria are vague and contradictory and do not permit of bacteriological identification. *2:* They evidently belong to one of numerous species of intestinal flora. *3:* The cycles on which Ferran bases his theory have been confirmed by no other author, although the reversible cycle *in vitro* might appear partially supported by Arloing, Courmont and Vaudremer. *4:* The "anti-alpha" vaccine is a mixture derived from intestinal flora and partly attenuated. They do not belong to the colon-typhoid group. *5:* Therapeutic and prophylactic value of the vaccine is unproved. *6*: Experimentally the vaccine does not protect cattle against tuberculosis.—*Le Vaccin Anti-Alpha de J. Ferran, A. Saenz and J. M. Estape, Rev. d. l. Tuberc., April, 1928, ix, 195.*—*(A. P.)*

Intrarenal Tuberculin Reactions.—The tuberculin reaction, occurring when the specific protein of the tubercle bacillus comes in contact with the hypersensitive tissue of a tuberculous animal, illustrates several of the well known histological features of acute and and chronic inflammation. There is an acute exudative stage with degeneration or necrosis of local tissue, followed by a stage of repair in which the products of the acute reaction are removed by absorption or proliferative organization of the exudate. Both of these stages may be clearly seen in the familiar tuberculin skin test and testicular reactions. Tuberculin reactions of varying intensity may be produced in other organs. It has been suggested that nephritis may at times occur as a manifestation of an allergic reaction. This theory is supported by the observations of Longcope on the effect of intravenous injection of foreign proteins into animals sensitized to these proteins. Impressed by the severity of injury produced by tuberculin in the testis of a sensitive animal, the authors have attempted to produce analogous intrarenal tuberculin reactions by injection of tuberculin directly into the body of the kidney. For the procedure swine were found most suitable as they can be easily made sensitive to tuberculin and their renal arteries can be readily exposed and injected. The method of injection was similar to that recently reported by Miller and Appelbach, and the kidneys were perfused with the tuberculin solution at pressures of 20 to 30 mm. Hg. above the blood-pressure in the renal artery. The tuberculin employed was Seibert's pure-protein tuberculin. This was dissolved in weak sodium-hydrate solution and reprecipitated in a finely flocculent suspension by the addition of a few drops of N/10 hydrochloric acid. The suspension, which was faintly acid, was then added to a solution containing 1 per cent sodium citrate and 0.5 per cent sodium chloride. One hundred cubic centimetres of this preparation, containing 35–100 mgm. of tuberculin protein, was introdued into the isolated renal artery of the experimental animal under ether anaesthesia, the kidney being exposed extraperitoneally by lumbar incision. Six young swine were used in the experiments reported. Three of these were normal controls. Two had localized lymph node tuberculosis produced by inoculation with 10 mgm. of human tubercle bacilli, and one a plastic peritoneal tuberculosis from intraperitoneal injection. Almost constantly the perfusion produced symptoms of shock in the tuberculous animals, while the normal pigs were unaffected. As a rule the left kidney was perfused first and the right kidney some weeks later. In one instance a second perfusion of one kidney was made. The experiment was of a year's duration. The anatomical effect of the injection was determined by biopsy, nephrectomy, or killing the animal. The course of functional change was followed by analyses of the fasting blood and simple examination of the urine. In two animals, receiving 100 and 70 mgm., respectively, of tuberculoprotein, the perfused kidney was found to be simply a small hydronephrotic sac postmortem. The results of the above experiments show that by means of the intrarenal tuberculin reaction it is possible to produce a diffuse inflammation of the kidneys that may properly be considered an acute glomerulonephritis This effect is the result of a true tuberculin reaction, as it does not occur following the perfusion of the kidney of a nontuberculous animal with tuberculin. The immediate reaction in the kidney is followed by a subsidence of acute manifestations, and absorption and proliferative organization of the exudate. Many of the glomeruli in this stage show the epithelial and endothelial stimulation and growth seen in a late "acute proliferative glomerulonephritis," or in a subacute glomerulonephritis. True epithelial crescents are occasionally seen. Atrophy of the tubules associated with the more severely injured glomeruli occurs. When the injury is bilateral a moderate nitrogen retention develops. This was seen regularly in the tuberculous pigs which had been subjected to renal tuberculin perfusion, and never in the nontuberculous animals similarly treated. Several months after the reaction, almost complete restoration to an anatomical normal occurs, at least if very young pigs are used, as was the case in the present experiment. As the animals grow and the kidneys develop to normal bulk, the glomeruli increase in size corre-

spondingly. The only persisting signs of the former acute inflammation are small hyaline areas which occasionally contain old pycnotic polymorphonuclear leucocytes. These are usually located at the point of vascular attachment of the tuft and capsule. Simultaneously with this anatomical healing, complete functional recovery also occurs, as shown by a disappearance of nitrogen retention and return of the blood to normal. Has the artificial production of the nephritis here described any relation to the spontaneous development of nephritis in man? It is conceivable that during the period of activity of a tuberculous focus, tubercle-bacillus protein could be taken up, as by phagocytic cells, from the debris of the lesion and excite changes of an allergic nature at a distant point, such as a glomerulus of a kidney. It is unlikely, however, that any such dosages as used in the above experiment could be so absorbed. But it is possible that occasional and scattered glomerular lesions could arise in this way.—*Experimental Glomerulonephritis Produced by Intrarenal Tuberculin Reactions, with Plates, E. R. Long and L. M. Finner, Am. J. Path., November, 1928, iv, 571.—(J. S. W.)*

Effect of Old Tuberculin on Normal Leucocytes in Vitro.—A number of investigators have studied the effect of tubercle bacilli on the morphology of explanted tissues. It was thought that the next step of interest would be to determine whether, coincidentally with morphological changes, typical immunological reactions of tuberculosis could also be observed in explanted tissues. The first observations were confined to the hypersusceptibility of normal blood cells to tuberculin. Chicken leucocytes were cultured in Carrel D5 flasks to allow prolonged observations under conditions of uninterrupted growth. The technique described by Carrel was exactly followed. O. T. was used in part, prepared from strain H37 and avian strain 118 and, in part, also obtained from the New York Board of Health. Dilutions were always made in Tyrode's solution immediately before use. Unless mentioned otherwise 1 cc. of the diluted tuberculin was added ordinarily to the surface of coagulated plasma of twenty-four-hour-old cultures and allowed to stay in contact for twenty-four hours. Concentrated sterile glycerine-broth, properly diluted, was used as a control in some of the experiments. Altogether, 226 cultures were employed for the experiments concerned with the standardization of tuberculin. Slide cultures were not reliable and were employed only to obtain preliminary observations. Since the cultures were not used until after twenty-four hours' cultivation, it was impossible to establish the effect of tuberculin on the polymorphonuclear neutrophile leucocytes. The cellular response to be described concerned, therefore, only the monocytes, which multiplied and persisted in the majority in every culture. The criteria used for determining the effect of tuberculin can be described in a general manner as follows: If a toxic dilution of tuberculin was added to a culture, death of the cells occurred, the number depending on the toxicity of the tuberculin. An active living cell became round and, as a rule, considerably smaller. The protoplasm appeared dark and granular. The migration naturally ceased, and the dead cells formed large clumps. In the course of the following few days an almost compete disappearance of the dead cells was frequently noticed. Often only occasional surviving cells were seen in an otherwise entirely clear culture clot. Then these cells began to recover, and continued to migrate and multiply. Dissolution of the dead cells was not essential to the recovery of leucocytic cultures. In many instances surviving cells found their way through the dense masses of dead cells and formed a new profuse growth. Recovery of the first type was accompanied by the emergence of what appeared to be normal monocytes, and recovery of the second type by the emergence of hypertrophied monocytes, which were highly active. The effect of glycerine-broth on normal leucocytes was first studied. Glycerine-broth was added to a series of twenty-four-hour cultures in dilutions of 1:200 and 1:300. Two cultures received Tyrode's solution and one culture received a mixture of serum, Tyrode's solution and embryonic juice. After twenty-four hours the cultures were washed and further treated in the usual manner. Observations made during the following two weeks proved that glycerine-broth, in the dilutons employed, was nontoxic. Moreover it seemed that it has a slightly stimulating effect as compared with Tyrode's solution. The effect of B. H. tuberculin (obtained from New York Board of Health) was then studied. Dilutions were made up to 1:1500 and twenty-four-hour cultures were treated with 1-cc. amounts as in the previous experiment. A dilution of 1:1300 proved slightly toxic and 1:1400 did not have any toxic effect. The next study was made with free-flame H37 O.T., batch one. Dilutions were made from 1:100 up to 1:500 and cultures treated as above. The cultures receiving the 1:200 dilution showed many dead cells after twenty-four hours. During the next few days they showed improvement, and on the seventh day a dense growth of hyper-

trophied filament-like exceedingly long cells which formed an almost continuous layer. Such a culture was transplanted, and was in excellent condition tenty-four hours after transfer. The cultures receiving the higher dilutions remained in excellent condition. The effect of free-flame and water-bath H37 tuberculin, batch 2, and avian tuberculin on normal leucocytes was not studied. Both free-flame and water-bath tuberculin from batch 2 had a higher toxicity than batch 1. A dilution of 1:500 was rather toxic but the number of dead cells was considerably less than that receiving 1:300. Almost complete recovery was noticed on the third day. Avian tuberculin proved somewhat toxic at 1:1200, but 1:1400 did not have any toxic effect. Various degrees of toxicity of O. T. were found to exist for normal leucocytes. In dilution in which there was a mild toxicity which brought about considerable mortality, recovery of the surviving cell was accompanied by the appearance of certain highly active cells. These were hypertrophied filament-like, extremely long leucocytes with a pronounced tendency to anastomose by means of distant pseudopads. Reversion to normal appearance was not observed even on transplantation. The toxicity of the tuberculin was not due to variations of pH, since tuberculin diluted with Tyrode's solution not less than 1:100 was always of pH 7.8 to 8.0. Additional information was gained by the study of a culture fixed in formalin and stained with haematoxylin or azure-blue. A culture was treated with B. H. tuberculin, 1:900 dilution. During the first few days there were numerous dead cells, but the culture recovered in the course of one week. Microscopic examination of the stained preparation revealed that tuberculin was able to induce peculiar morphological changes *in vitro*. These consisted of the appearance of hypertrophied filament-like monocytes. Their main characteristic was their ability to fuse and form giant cells. Incidentally, cells resembling epithelial cells were seen in large numbers. These changes were considered characteristic of the histology of the tubercle *in vivo*. *Conclusions:* Tuberculin possesses *in vivo* a toxicity for normal leucocytes. The toxic factor is heat-resistant. The significance of this factor is still to be determined; work on this point is in progress. Its relation to factors toxic for the whole animal, as found by earlier writers, should also be determined. Coincidentally, tuberculin is able to influence to a great extent the morphological appearance of the monocytes. Definite changes once made under stimulation by tuberculin persist in the culture in which they are initiated. Moreover, reversion to the normal appearance is not observed even on transplantation to a new culture medium. The changes induced are characteristic of tuberculosis. It is believed that it is possible to reproduce the tubercle *in vitro* by means of tuberculin.—*Immunologic Reactions in Tissue Cultures. I. The Effect of Tuberculin O. T. on Normal Leukocytes in Vitro, G. Schwartzman, Arch. Path., November, 1928, vi, 773.*—(*F. G. P.*)

Effect of Old Tuberculin on Normal Leucocytes In Vitro.—In a previous report it was shown that tuberculin is toxic for normal leucocytes and able to induce certain morphological changes characteristic of tuberculosis. The work reported in this paper had in view (1) comparison of the morphological changes in tuberculin-treated cultures with those treated with live tubercle bacilli, and (2) a determination of the optimal conditions for inducing morphological changes under the influence of tuberculin. The same methods were employed as were used in the previous work. The effect of live tubercle bacilli on normal leucocytes was first studied. A small clump of tubercle bacilli was deposited next to the blood fragment before coagulation of the culture medium occurred. This became surrounded by migrating leucocytes, in the course of the first twenty-four hours. When, however, the bacillary clump was deposited at some distance from the fragment, the migrating cells, instead of surrounding the explant, directed themselves toward the clump. The leucocytes about the bacillary clump were killed off. In a different plane of the same area or among clusters of dead cells slightly elongated amoeboid cells with homogeneous protoplasm were observed. After twenty-four hours and later the areas at some distance from the bacillary clumps consisted of a rather dense layer of active, morphologically normal monocytes. The bacilli grew in the same culture. Towards the end of the first week of incubation there were persisting areas of normal monocytes especially, close to the bacillary clump, but long, digitate, stellate and filiform cells. These cells showed a definite tendency to clump and the lacy appearance of cultures infected with tubercle bacilli was a highly conspicuous feature. The ability of these hypertrophied cells to grow in close proximity to bacillary clumps and to appear among the dead tubercle bacilli suggested a definite resistance to the toxicity of this microörganism. Epithelioid cells appeared at the beginning of the second week and persistently increased. Toward the end of the second week they underwent rapid degeneration. A series of experiments were performed to determine the optimum condition for inducing mor-

phological changes in explanted leucocytes by means of O.T. Cultures were treated with various dilutions as in the previous work. The ability of tuberculin to produce morphological changes varied with the batch employed. There was no significant variation in this property in two batches prepared from the same strain (H 37). There was, however, a definite difference in tuberculin derived from another strain. Higher dilutions produced these changes invariably. In the majority of instances, the toxicity of tuberculin ran parallel with the morphological changes. However, in two experiments with the second batch of "free-flame", H37 tuberculin, the dilution of 1:300 was invariably toxic but did not induce morphological changes. These changes typical of tuberculin always occurred after an interval of from five to nine days. It was assumed that the observed period of incubation was necessary because the leucocyte had to reach a certain age to become susceptible to tuberculin. The effect of "free flame," H37 tuberculin (batch 2) on the morphology of normal leucocytes of different ages was not studied. Tuberculin was added to cultures after various incubation periods,—1, 3, 6 and 9 days. The old cultures underwent definite morphological changes typical of tuberculosis within forty-eight hours after the addition of tuberculin. The promptness of the changes was in contrast with observations made on young cultures treated with the same dilutions of tuberculin. In young cultures the changes occurred only occasionally, and when they did occur an incubation period of seven to nine days was required. The aged cultures were also more susceptible to higher dilutions. At present it is assumed that the aged monocytes undergo certain biological changes in the process of cultivation, and that these elements enable them to transform into tuberculous elements on proper stimulation. The tuberculin added to the culture is probably absorbed by the clot and possibly also by the cells. There it stimulates the proper changes as soon as the cells are ready for it. Occasionally in the course of the work, series of leucocytic cultures were obtained which appeared somewhat peculiar. The monocytes were elongated and frequently filament-like, and had a variable tendency to grow in small groups and in chains. Gradually thereafter the sets would resume a normal appearance, this taking place from about the eighth to tenth day of cultivation. In the next study on the variations in susceptibility to tuberculin, both the normal leucocytes and those showing atypical growth were included. A series of normal leucocytic cultures was treated in the usual manner and not used for any experimental purpose until the ninth day. On the third day of incubation many cultures showed cells resembling somewhat the filiform, hypertrophied monocytes of tuberculous cultures. On the eighth day the cells appeared normal. To some of these cultures H37 and B. H. tuberculin were added on the ninth day. Twenty-four hours later their appearance was typical of cultures of tubercle. This appearance persisted until the end of the period of observation, namely, from about eight to ten days. Four control cultures did not show any abnormal appearance during this time. To a set of normal cultures tuberculin, in the same dilution as used for the abnormal cultures, was added on the eight day. In forty-eight hours all the tuberculin cultures had become filament-like monocytes scattered singly or in small anastomosing groups. On the third day the cultures had reverted to normal appearance. *Conclusions:* Both the tuberculin and live tubercle bacilli had a similar effect on the morphological appearance of these cultures. The ability of tuberculin to stimulate these changes varied with the batch employed. In different preparations with tuberculin of the same strain little variation appeared, but in preparations of different strains there was a considerable difference in stimulating changes. When added to a young culture, tuberculin stimulated morphological changes after a certain period of incubation. It took effect more quickly when added to aged leucocytic cultures. Moreover, higher dilutions of tuberculin produced the changes in older cultures. It was concluded that aged leucocytic cultures undergo the changes more readily and are more susceptible than recently explanted leucocytes. There were variations in the susceptibility of aged leucocytes to the effect of tuberculin. The cultures which showed certain reversible abnormalities were more susceptible to this effect than normal cultures. The morphological changes were independent of the toxic effect of tuberculin, since in certain dilutions which brought about the changes there was not noticeable toxicity. It is possible that a slight toxicity excaped observation.—*Immunologic Reactions in Tissue Cultures. II. Analysis of the Effect of Tuberculin O. T. on the Morphology of Normal Leukocytes in Vitro, G. Schwartzman, Arch. Path., November, 1928, vi, 790.—(F. G. P.)*

Exacerbation of Tuberculin Reaction by Therapeutic Serum.—In a children's ward all patients received an intramuscular

injection of 10 cc. of Moser's scarlet-fever serum. Fifteen of the children developed serum rash; seven of these had been treated with Löwenstein's tuberculin ointment. All seven showed an acute exacerbation of the local tuberculin reactions.—*Wiederaufflammen kutaner Tuberkulinsalbenreaktionen (Dermotubin) hervorgerufen durch Serumexanthem bei Kindern, H. Maendl and K. Blaschke, Wien. klin. Wchnschr., November 22, 1928, xlvii, 1613.*—(*M. P.*)

Intracutaneous Tuberculin Tests.—Forty-six healthy male adults were given intracutaneous tuberculin tests. The results in this healthy group were compared with the results in 150 tuberculosis patients. It was observed that the percentages of positives and the extent of the raised area of reaction in the healthy persons were 20 per cent higher than in the persons actually suffering from tuberculosis. Thirty-two patients in the third stage of phthisis were divided into recrudescent (20) and initial (12) type. Though these figures are small it was noted that patients who are able to hold their temperature in control are also the patients with a sharp power of reaction to tuberculin.—*The Significance of Intradermal Tuberculin Tests, S. L. Cummins, Brit. M. J., February 23, 1929, no. 3555, 336.*—(*W. I. W.*)

Artificial Maintenance of Hypersensitiveness to Tuberculin.—The author attempted in various animal experiments to exactly outline the requirements for maintaining an increased hypersensitiveness for tuberculin and for this purpose used Old Tuberculin and bacillary emulsion, and succeeded without occasioning fever or toxic symptoms. The intracutaneous injection of dead tubercle bacilli, according to the method of Langer, caused slight reactions in the form of erythemata and infiltration, which were, however, not permanent and histologically revealed no tuberculous tissue.—*Zur Frage künstlicher Erhaltung einer erhöhten Empfindlichkeit gegen Tuberkulin, W. K. Kaiser, Zeitschr. f. Tuberk., 1928, l,* 329.—(*H. J. C.*)

Cross Sensitization to Tuberculin.—Cattle are occasionally found which react to tuberculin but at autopsy exhibit nothing more than a few cutaneous lesions, in some of which acid-fast bacteria are found. It is known that guinea pigs inoculated with nonpathogenic acid-fast bacilli react to tuberculin. Several lots of guinea pigs were inoculated with various acid-fast bacilli and an acid-fast strain recovered from a cutaneous lesion of a hog. After thirty days they were tested with avian and human tuberculin, some intraperitoneally (large doses) and some intracutaneously. In none of the groups receiving intracutaneous injections of tuberculin was there a reaction. In 60 per cent of those inoculated with timothy bacilli, skin reactions occurred to human tuberculin; none reacted to avian tuberculin. The most marked reactions occurred in those inoculated with the acid-fast bacillus isolated from a hog (skin). There were a few reactions to human tuberculin in those inoculated with a milk bacillus, but no reactions to the avian variety. Very little response could be elicited when animals inoculated with a fish bacillus or with Friedmann's turtle bacillus were tested with the two types of tuberculin. This was true also of those inoculated with smegma bacilli and bacilli recovered from nasal secretions Those inoculated with mist bacilli gave slight reactions to both tuberculins, while those with grass bacilli gave good reactions to both avian and human tuberculins. In general there was greater sensitiveness to human than to avian tuberculin. There was a good deal of individual variation among animals in the same groups, and in general the reactions are to be thought of as being inconstant and atypical.—*The Relationship of the Lethal Power to the Skin-Reacting Power of Tuberculin, M. Dorset, R. R. Henley and H. E. Moskey, J. Am. Vet. M. Ass., July, 1927, lxxi, 487,*—(*H. S. W.*)

Allergy and Serum Anaphylaxis.—Blocking of the reticuloendothelial system with india ink does not suppress or reduce the tuberculin shock in tuberculous guinea pigs, while anaphylactic shock is usually suppressed after such treatment. The intracutaneous tuberculin reaction is not influenced by blocking the reticuloendothelial system. The same results were obtained after blocking and extirpation of the spleen. It may then be stated that tuberculosis allergy is independent of the functional state of reticuloendothelial cells which establishes a fundamental difference between tuberculin hypersensitiveness and serum hypersensitiveness. Serum anaphylaxis either could not be elicited, or it was greatly diminished in tuberculous guinea pigs. The lowered sensitiveness of tuberculous animals to a reinjection of serum may have the same cause as the lowered sensitiveness of tuberculous animals against gold preparations. The factor which prevents serum anaphylaxis in sensitized tuberculous animals can be passively transferred to nontuberculous sensitized animals by intraperitoneal injection

of tissue.—*Tuberkuloseallergie und Serumanaphylaxie, W. Pagel, Klin. Wchnschr., April 16, 1929, viii, 742.*—(*M. P.*)

Allergy and Strain Specificity of Tubercle Bacilli.—The histologic picture of a primary intracutaneous infection varies with the virulence of the strain. Already three hours after the injection differences can be noted. With decreasing virulence the abscess-formation becomes larger and lasts longer, the histiocytic-epithelioid reaction occurs later and to a lesser extent. Essentially the same differences, but to a much more marked degree, were observed in allergic animals.—*Tuberkuloseallergie und Bacillenstamm, Pagel, Klin. Wchnschr., January 22, 1929, iv, 170.*—(*M. P.*)

Immunization of Guinea Pigs against Tuberculosis.—The author reports immunizing experiments similar to those previously tried on rabbits, in which spleen and thymus extracts were allowed to act upon tubercle bacilli and were used as vaccines. This study is concerned with the effects on guinea pigs. The animals were treated with increasing amounts by subcutaneous injection at intervals of 8 to 14 days over periods of months. Treatments were administered intraperitoneally or intravenously, and then the animals were infected subcutaneously partly before and some after treatment. The guinea pigs treated after infection were given alternate injections of the vaccine and organ extracts from either thymus or liver, while another series was given dead tubercle bacilli, the controls consisting of untreated animals merely infected. Body weight, duration of life and the anatomical form of the tuberculosis were used as criteria. While the controls died on an average of 15 weeks after infection and lost an average of 30 gm. the treated guinea pigs revealed a more or less inhibition of the infection. Those treated with dead tubercle bacilli died in 17.6 weeks, on the average, and gained on an average of 67 gm., while those given prior treatment of liver-extract vaccine lived 23.4 weeks and gained 80.7 gm., and the thymus-extract vaccine-treated animals lived 23.6 weeks and gained 134 gm. In the latter group of animals the changes were predominantly of a proliferative cirrhotic nature, while in the other series the caseous exudative pneumonic form of disease existed. There was no particular difference between the animals treated prior to and subsequent to infection and those only treated prior to infection. It is pointed out that the killed virus also has immunizing properties.—*Über Tuberkulose-Immunisierungsversuche beim Meerschweinchen, G. Schröder, Zeitschr. z. Tuberk., 1928. l. 61.*—(*H. J. C.*)

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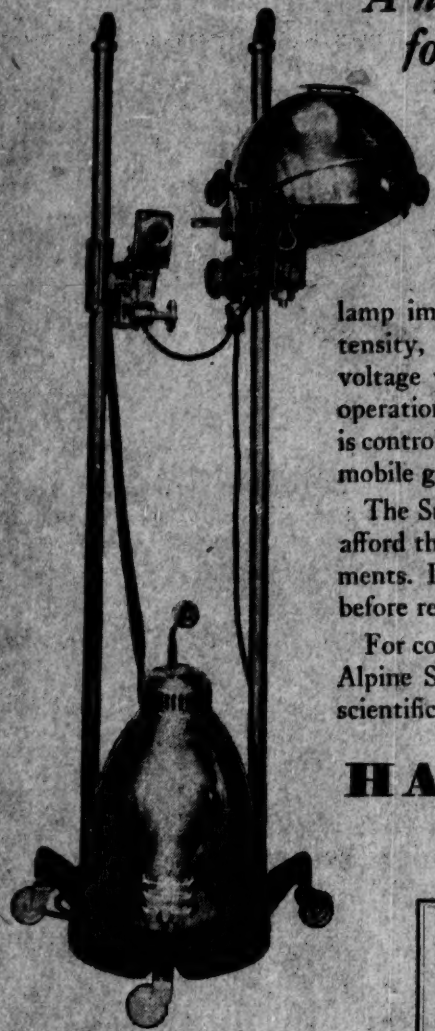

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